US 20120059375A1

(19) **United States**

(12) **Patent Application Publication**

Couture et al.

(10) **Pub. No.: US 2012/0059375 A1**

(43) **Pub. Date: Mar. 8, 2012**

(54) **ASYMMETRICAL ELECTRODES FOR BIPOLAR VESSEL SEALING**

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(21) Appl. No.: **12/877,482**

(22) Filed: **Sep. 8, 2010**

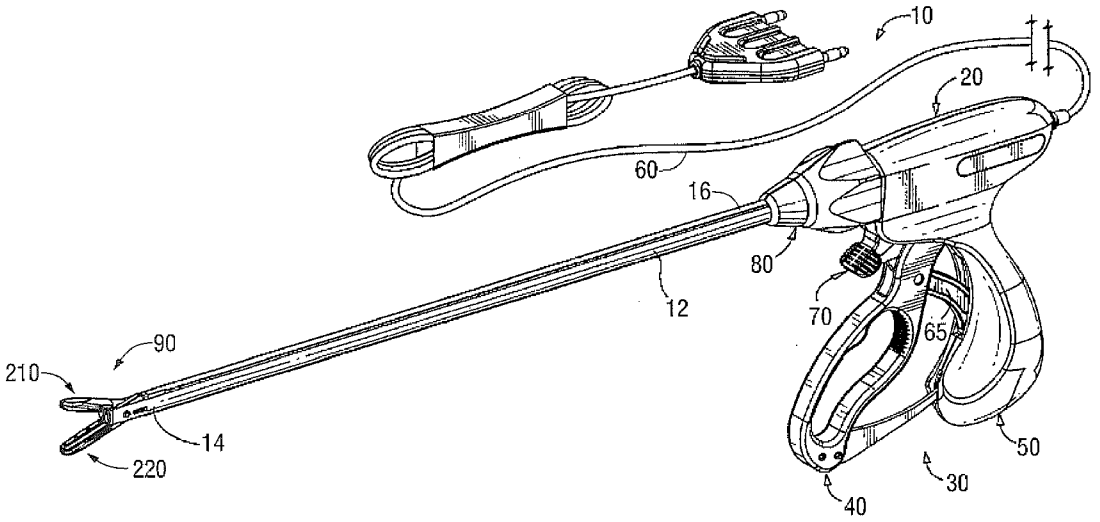
Publication Classification

(51) **Int. Cl.**
A61B 18/18 (2006.01)

(52) **U.S. Cl.** **606/51**

(57) **ABSTRACT**

Bipolar electrosurgical instrument having a first and a second opposing jaw member at a distal end thereof, wherein each jaw member includes an outer housing, and an inner tissue engaging surface corresponding to the inner tissue engaging surface of the opposing jaw. The instruments includes the ability to move the jaw members relative to one another from a first position wherein the jaw members are disposed in spaced relation relative to one another to a second position wherein the jaw members cooperate to grasp tissue. The jaws include asymmetrical electrodes disposed on the inner tissue engaging surfaces. A first contact region of the electrode has a greater surface area than that of the second contact region. During resection procedures wider electrodes impart improved sealing energy to the patient-side vessel while providing sufficient energy to resected tissue to effect hemostasis.



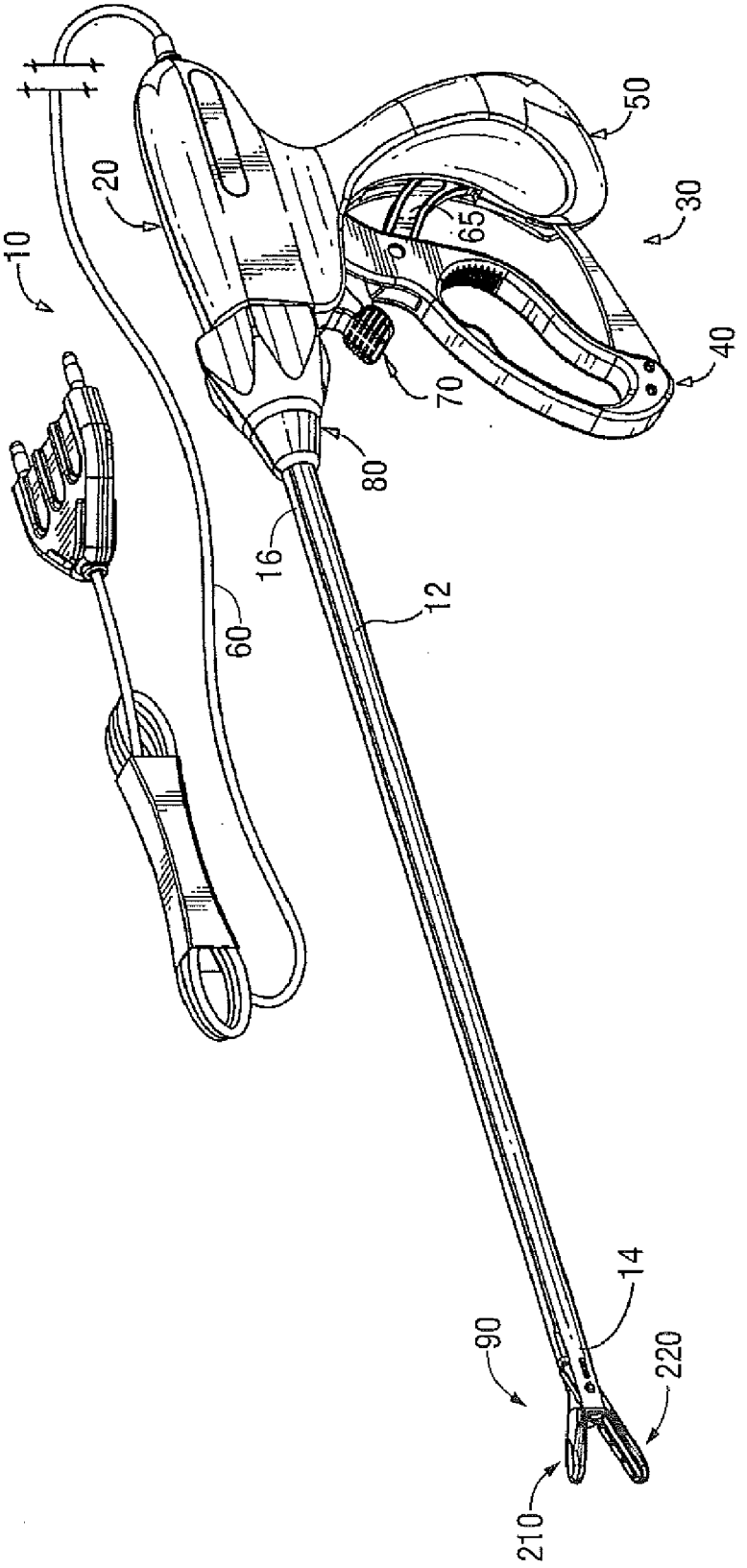


FIG. 1

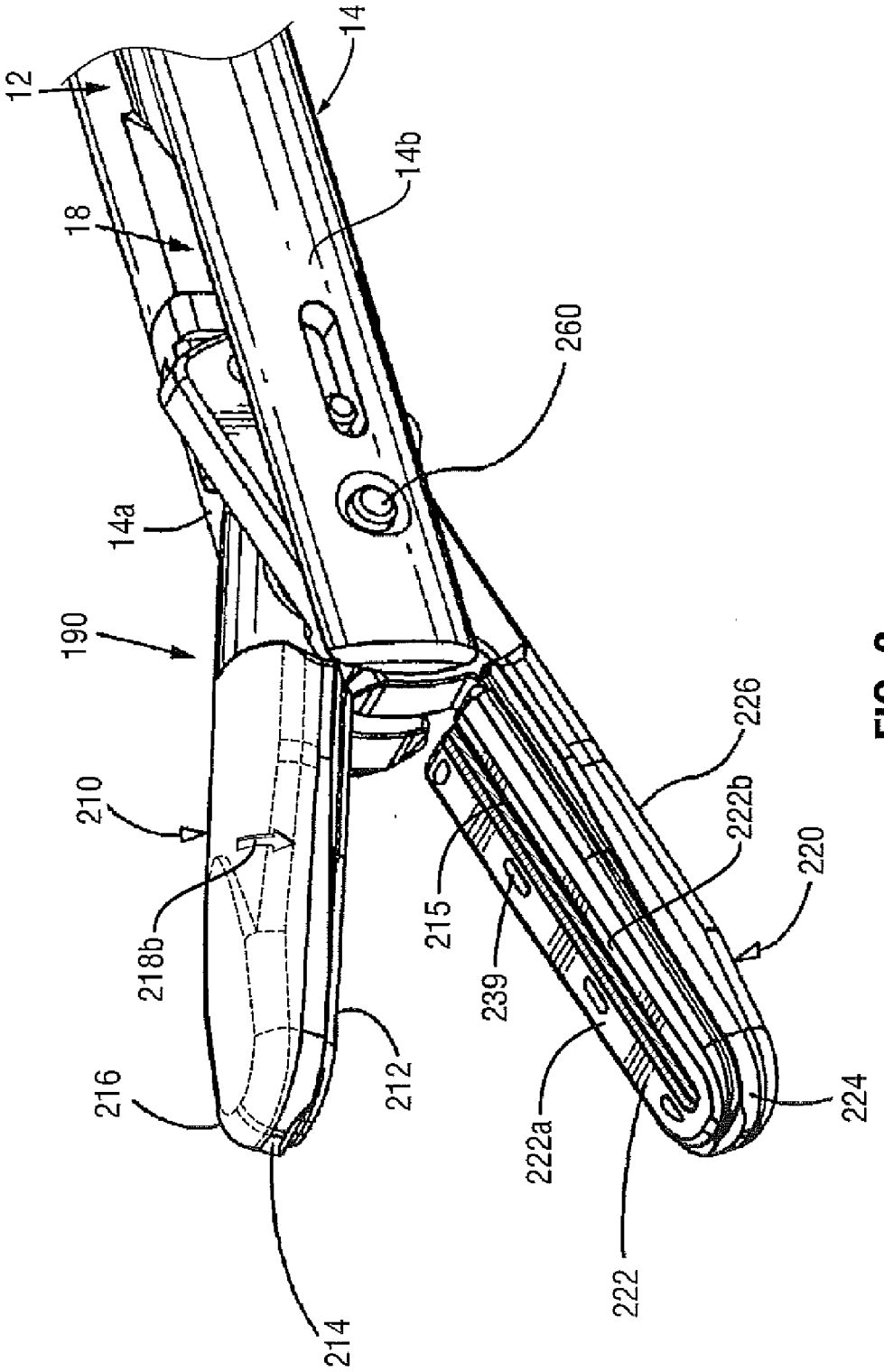

12
14
14b
18
260
14a
190
210
226
222b
220
218b
215
239
216
212
224
222a
222
214

FIG. 2

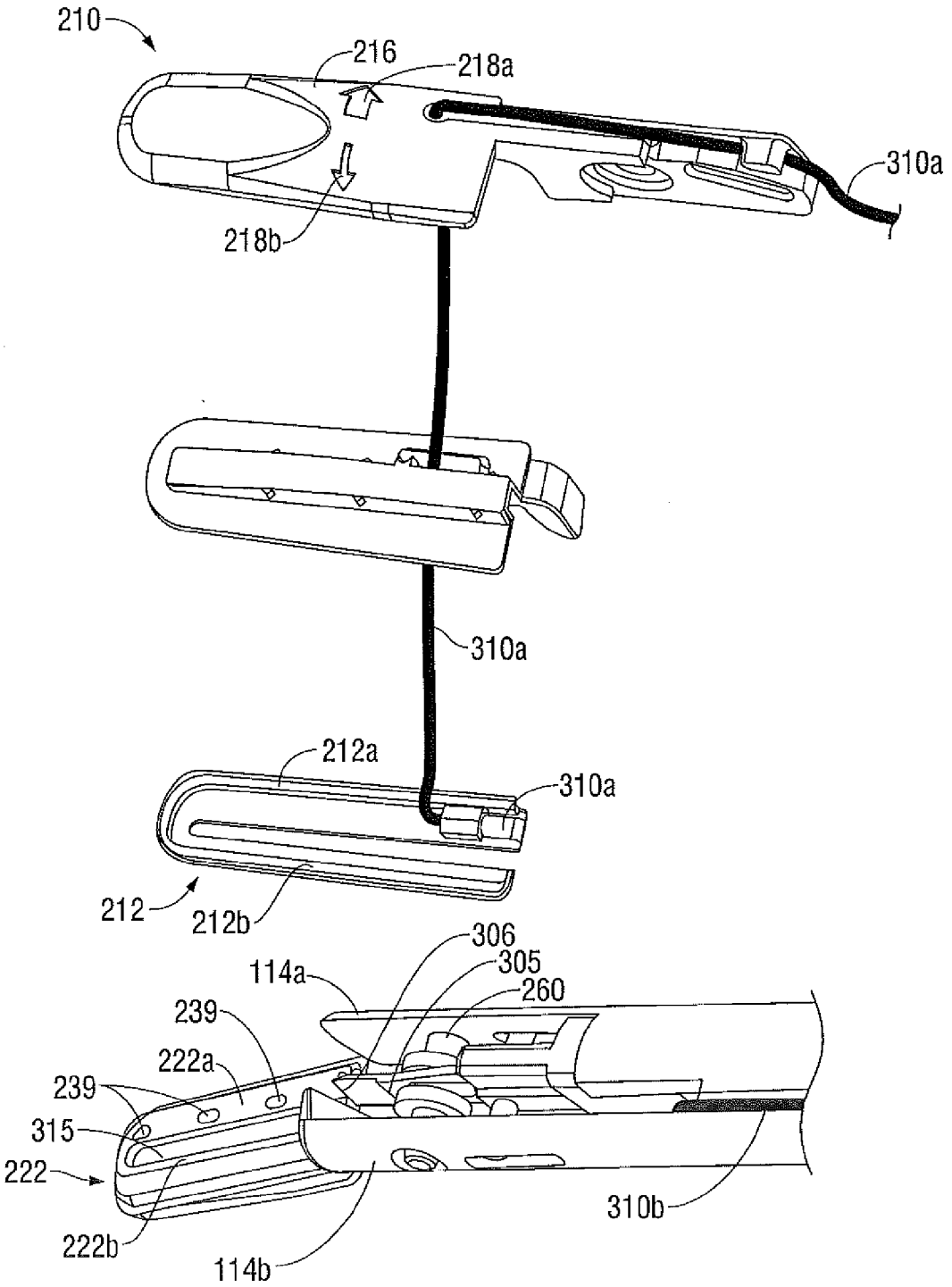

210
216
218a
310a
218b
310a
212a
310a
212
212b
306
305
114a
260
239
222a
239
315
222
310b
222b
114b

FIG. 3

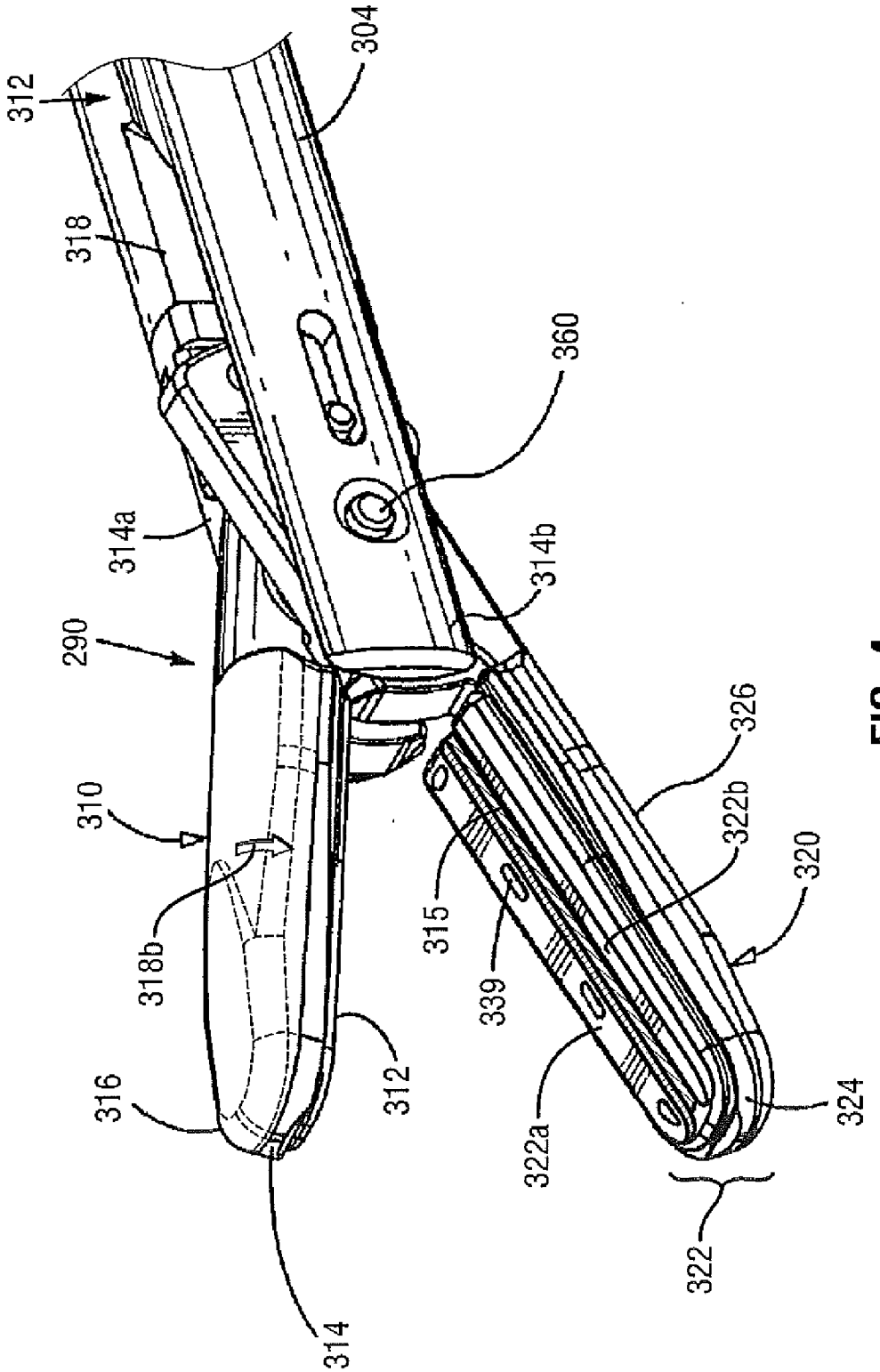

312
304
318
360
314a
314b
290
310
326
322b
320
315
318b
339
316
312
324
322a
322
314

FIG. 4

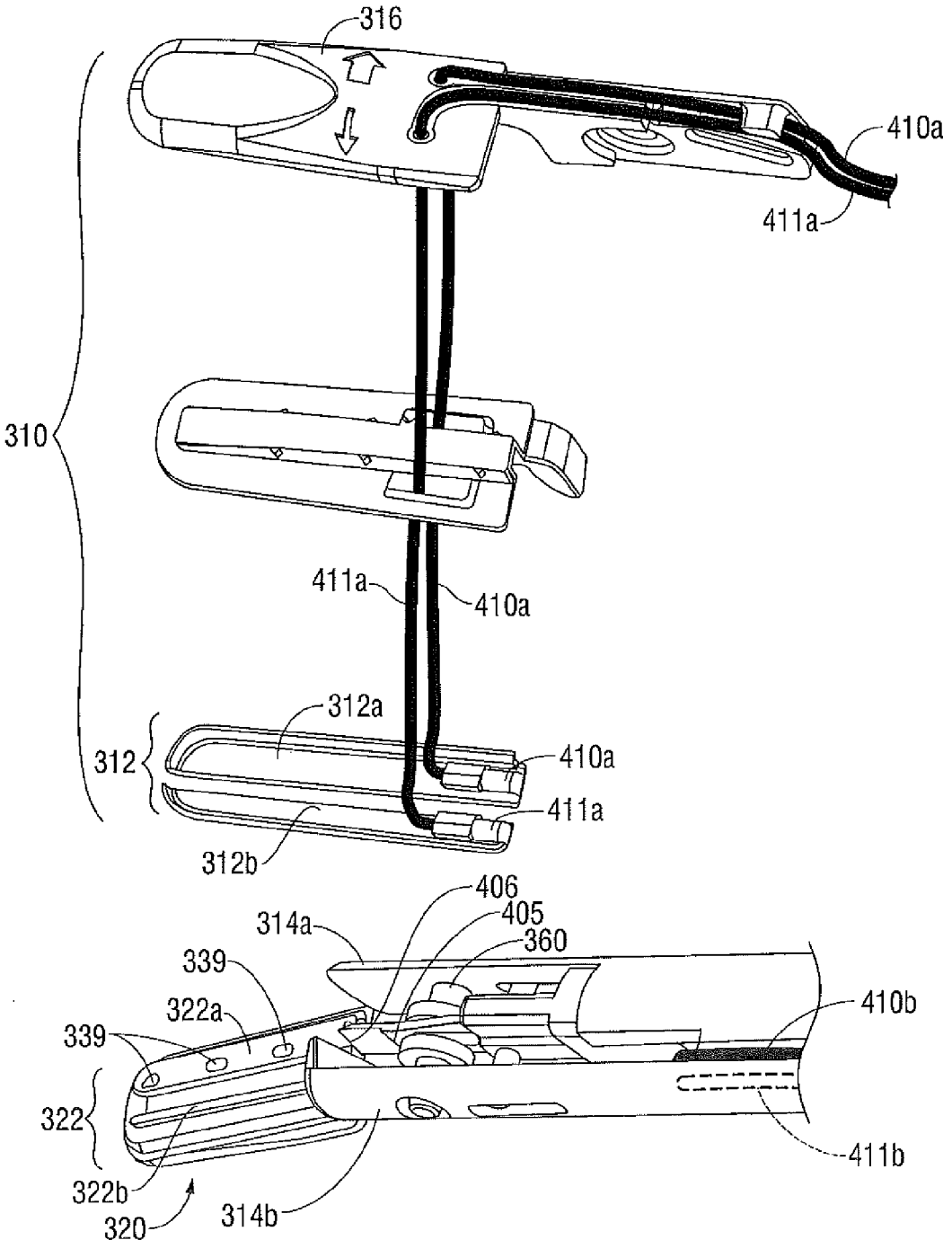

316
410a
411a
310
411a
410a
312a
312
410a
411a
312b
406
405
314a
360
339
322a
339
410b
322
411b
322b
320
314b

FIG. 5

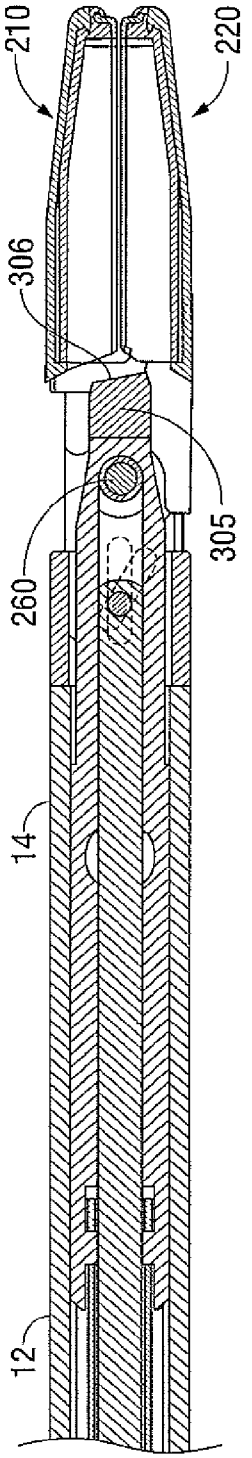


FIG. 6A

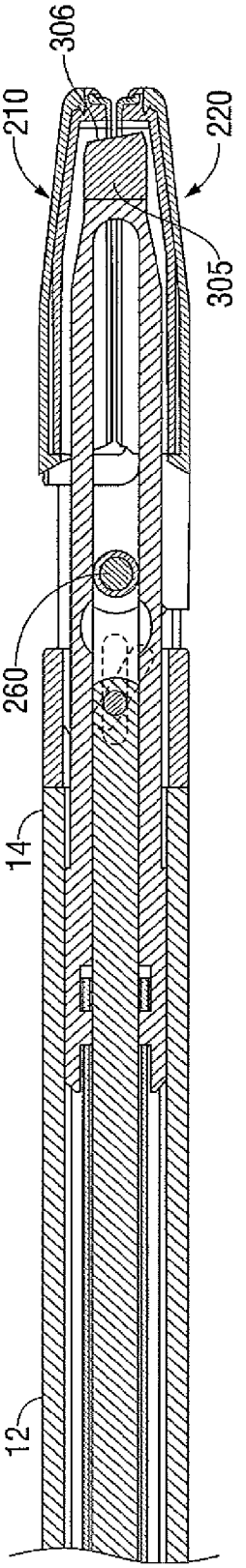


FIG. 6B

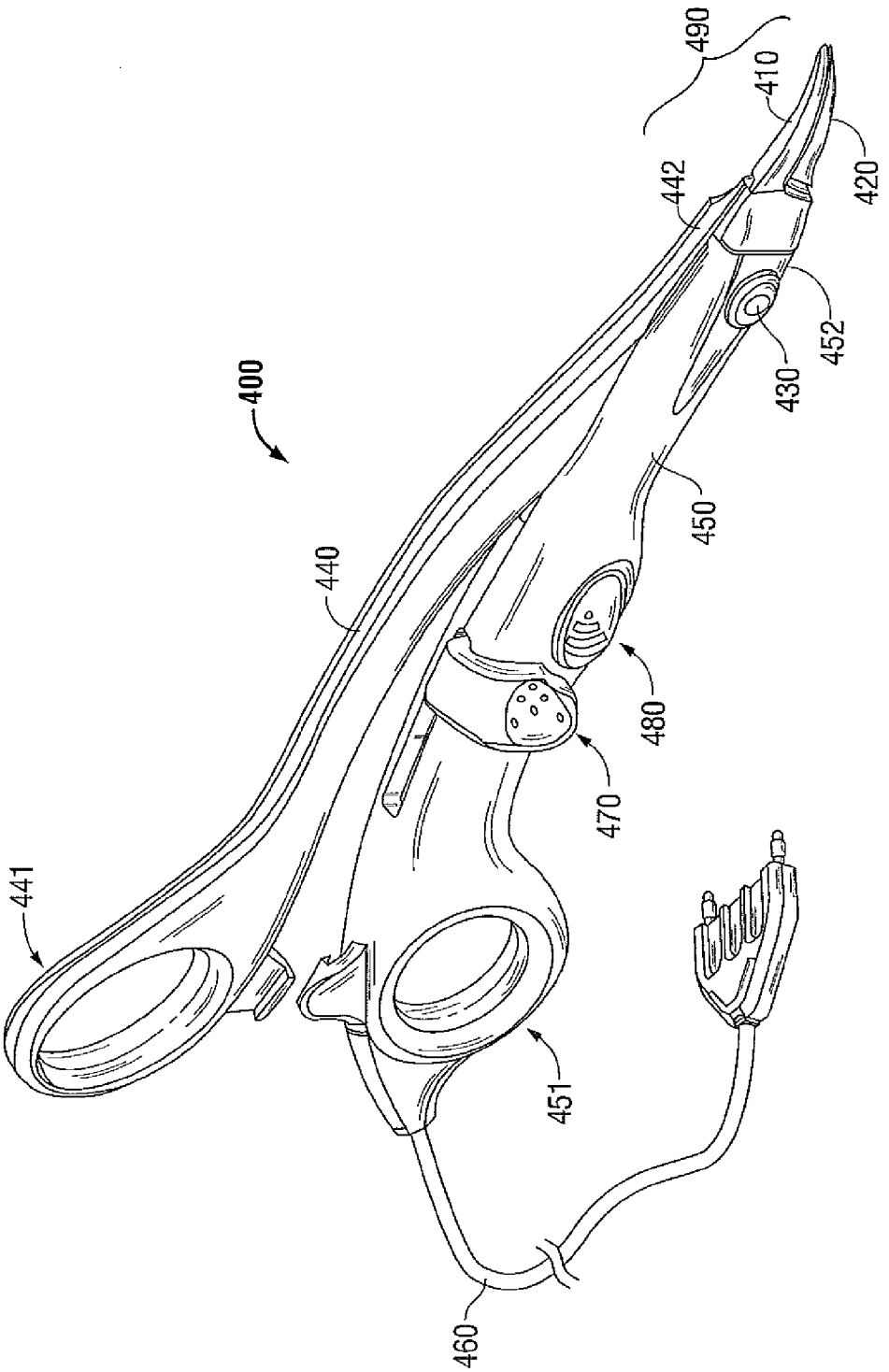


FIG. 7

ASYMMETRICAL ELECTRODES FOR BIPOLAR VESSEL SEALING

BACKGROUND

[0001] 1. Technical Field

[0002] The present disclosure relates to electrosurgical instruments and methods for performing surgical procedures and, more particularly, to a bipolar electrosurgical forceps having an asymmetrical electrode configuration.

[0003] 2. Background of Related Art

[0004] A hemostat or forceps is a simple pliers-like tool which uses mechanical action between its jaws to constrict vessels and is commonly used in open surgical procedures to grasp, dissect and/or clamp tissue. Electrosurgical forceps utilize both mechanical clamping action and electrical energy to effect hemostasis by heating the tissue and blood vessels to coagulate, cauterize and/or seal tissue. Such electrosurgical forceps may be used during conventional (open) surgery and during minimally-invasive (e.g., endoscopic) surgery. During minimally-invasive surgery, endoscopic instruments are inserted into the patient through a cannula, or port, which has been made with a trocar. The benefits of minimally-invasive surgery are well known, and include decreased operative times, faster recovery, and improved outcomes.

[0005] Electrosurgical forceps commonly include an electrode on each opposing jaw surface. By controlling the intensity, frequency and duration of the electrosurgical energy applied through the jaw members, and by regulating the clamping force applied by the jaws to tissue, a surgeon can cauterize, coagulate, desiccate and/or simply reduce or slow bleeding of vessels and tissue. In particular, accurate application of pressure is important to oppose the walls of the vessel; to reduce the tissue impedance to a low enough value that allows enough electrosurgical energy through the tissue; to overcome the forces of expansion during tissue heating; and to contribute to the end tissue thickness which is an indication of a good seal.

[0006] Many endoscopic surgical procedures require cutting blood vessels or vascular tissue. During certain endoscopic procedures, in particular, during resection procedures, vessels connecting the portion of the organ being resected must be cut to enable a surgeon to physically remove the organ from the patient's body. One portion of the severed vessel remains attached to the patient's vascular system, and the other portion of the severed vessel is removed with the resected organ.

[0007] Conventional vessel sealing instruments are often used during these types of resection procedures, and apply electrosurgical sealing energy equally to the patient side of the vessel and to the resected portion of the vessel. This approach may have drawbacks, because while the patient-side vessel seal must withstand in vivo fluid pressures, the resected-vessel seal need only prevent incidental leakage from the resected organ.

SUMMARY

[0008] The present disclosure relates to a bipolar forceps which includes a shaft having a first and second opposing jaw member at a distal end thereof and a drive assembly for moving the jaw members relative to one another from a first position, wherein the jaw members are disposed in spaced relation relative to one another, to a second position, wherein the jaw members cooperate to grasp tissue therebetween. The forceps are connected to a source of electrosurgical energy such that the jaw members are capable of conducting energy through tissue held therebetween to effect a tissue seal. A rotating assembly may also be included for rotating the jaw members about a longitudinal axis defined through the shaft. In embodiments, the forceps includes a selectively advanceable knife assembly for cutting tissue along the tissue seal.

[0009] The forceps include opposing electrodes disposed on inner facing surfaces of the jaw members. The first jaw member includes a first electrode and a second electrode. The first electrode has a surface area greater than that of the second electrode. The first and second electrodes may have any suitable shape, however, in an embodiment the first and second electrodes have an elongate shape, wherein the first and second electrodes have a similar length, and the first electrode has a width greater than that of the second electrode. The second jaw member includes counterpart (e.g., mirror-image) first and second electrodes such that the first, larger electrode of the first jaw member corresponds with the first, wider electrode of the second jaw member. Similarly, the second, narrower electrode of the first jaw member corresponds with the second, narrower electrode of the second jaw member. The first and second electrodes on each jaw may be electrically coupled or electrically independent.

[0010] The disclosed forceps may include an indicator to enable a surgeon to readily determine the position of the first and second electrodes. The indicator may be disposed on an outer surface of one or both jaws, on the shaft, and/or on the rotating assembly. The indicator may provide a visual indication (e.g., an icon, an arrow, a color, or other suitable visually-perceivable mark), a tactile indication (e.g., a raised area, a recessed area, a textured area, one or more "Braille-like" dimples, or other suitable feature perceivable by touch.)

[0011] During use, a surgeon may position the jaw assembly such that the side of the jaws corresponding to the wider electrode is positioned towards the patient-side vessel and the side of the jaws corresponding to the narrower electrode is positioned away from the patient-side vessel. In this manner, the wider electrodes may impart improved sealing energy to the patient-side vessel, and reduce the amount of wasted sealing energy to the portion of the vessel being resected.

[0012] The present disclosure describes an electrosurgical bipolar forceps having an electrode configuration for use in bipolar electrosurgical sealing and division, where the electrodes on one side of the jaws are larger than the electrodes on the opposite side of the jaws. The larger pair of electrodes are capable of effecting vessel sealing (e.g., capable of producing Ligasure™-quality tissue welds) while the smaller electrodes are well-adapted to effecting coagulation, e.g., to minimize blood in the surgical field. The disclosed instrument may include be equipped with an electrode and/or a blade capable of performing electrosurgical tissue division. The intended use of this device could be any surgical procedure where maintaining a quality seal is necessary on only one side of the device. An example of this is a polypectomy or lung wedge resection, where the excised portion of tissue would have minimal seal width and possibly reduced thermal spread for better assessment of disease states and margins. This may also allow the maximum seal width to be formed on the patient side of a resection while maintaining an overall smaller device footprint, a slimmer end effector and/or jaw assembly, and the like.

[0013] Desirably, at least one of the jaw members is made from a hard anodized aluminum having high dielectric prop-

erties. It is envisioned that the electrodes include a non-stick coating disposed thereon which is designed to reduce tissue adherence.

[0014] According to another aspect of the present disclosure, an electrosurgical forceps is disclosed. The disclosed forceps includes a shaft having a first and a second opposing jaw member at a distal end thereof. Each jaw member includes an outer housing, and an inner tissue engaging surface. Each jaw's inner tissue engaging surface corresponds to the inner tissue engaging surface of the opposite jaw. The forceps includes a drive assembly for moving the jaw members relative to one another from a first open position to a second closed position wherein the jaw members cooperate to grasp tissue therebetween. The jaws include an electrode disposed on the inner tissue engaging surface having a first contact region disposed adjacent to a first edge of the inner tissue engaging surface, and a second contact region disposed adjacent to a second edge of the inner tissue engaging surface. The surface area of the first contact region is greater than the surface area of the second contact region.

[0015] According to another embodiment, disclosed is an electrosurgical forceps having a shaft and a pair of opposing jaw members at a distal end thereof. Each jaw member includes an outer housing, and an inner tissue engaging surface corresponding to the inner tissue engaging surface of the opposing jaw. The forceps includes a drive assembly for moving the jaw members relative to one another from a first, open position to a second, closed position wherein the jaw members cooperate to grasp tissue therebetween. Each jaw includes a first electrode disposed on an inner tissue engaging surface and disposed adjacent to a first edge of the inner tissue engaging surface, and a second electrode disposed on an inner tissue engaging surface and disposed adjacent to a second edge of the inner tissue engaging surface. The surface area of the first electrode is greater than the surface area of the second electrode.

[0016] Also disclosed is a method of operating an electrosurgical forceps, comprising the steps of providing an electrosurgical forceps having a shaft having a first and a second opposing jaw member at a distal end thereof. Each jaw member of the provided forceps includes an outer housing, and an inner tissue engaging surface corresponding to the inner tissue engaging surface of the opposing jaw. The provided forceps includes a drive assembly for moving the jaw members relative to one another from a first, open position to a second, closed position wherein the jaw members cooperate to grasp tissue therebetween. A first electrode is operably coupled to a source of electrosurgical energy and disposed on the inner tissue engaging surface of the first jaw. The first electrode has a first contact region disposed adjacent to a first edge of the inner tissue engaging surface of the first jaw, and a second contact region disposed adjacent to a second edge of the inner tissue engaging surface of the first jaw. The surface area of the first contact region of the first electrode is greater than the surface area of the second contact region thereof. A second electrode is operably coupled to a source of electrosurgical energy and disposed on the inner tissue engaging surface of the second jaw. The second electrode has a first contact region disposed adjacent to a first edge of the inner tissue engaging surface of the second jaw, and a second contact region disposed adjacent to a second edge of the inner tissue engaging surface of the second jaw. The surface area of the first contact region of the second electrode is greater than the surface area of the second contact region thereof. The method includes the steps of closing the jaws to grasp tissue therebetween, and applying electrosurgical energy to tissue via the first electrode and the second electrode to cause a change to the tissue.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Various embodiments of the subject instrument are described herein with reference to the drawings wherein;

[0018] FIG. **1** is a left, perspective view of an embodiment of a bipolar electrosurgical instrument in accordance with the present disclosure showing a housing, a shaft and a jaw assembly having an asymmetrical electrode;

[0019] FIG. **2** is an enlarged, left perspective view of an embodiment of a jaw assembly having an asymmetrical electrode in accordance with the present disclosure;

[0020] FIG. **3** is an enlarged, partially-exploded view of the FIG. **2** embodiment of a jaw assembly having an asymmetrical electrode in accordance with the present disclosure;

[0021] FIG. **4** is an enlarged, left perspective view of another embodiment of a jaw assembly having an asymmetrical electrode in accordance with the present disclosure;

[0022] FIG. **5** is an enlarged, partially-exploded view of the FIG. **4** embodiment of a jaw assembly having an asymmetrical electrode in accordance with the present disclosure;

[0023] FIG. **6**A is an enlarged, cross-sectional view of the distal end of a jaw assembly in accordance with the present disclosure showing a knife assembly in a proximal position prior to the actuation thereof;

[0024] FIG. **6**B is an enlarged, cross-sectional view of the distal end of a jaw assembly in accordance with the present disclosure showing a knife assembly in a distal position subsequent to the actuation thereof; and

[0025] FIG. **7** is a perspective view of another embodiment of a bipolar electrosurgical instrument in accordance with the present disclosure having a jaw assembly that includes an asymmetrical electrode.

DETAILED DESCRIPTION

[0026] Particular embodiments of the present disclosure are described hereinbelow with reference to the accompanying drawings, however, it is to be understood that the disclosed embodiments are merely examples of the disclosure, which may be embodied in various forms. Well-known functions or constructions are not described in detail to avoid obscuring the present disclosure in unnecessary detail. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present disclosure in virtually any appropriately detailed structure.

[0027] In the drawings and in the descriptions that follow, the term "proximal," as is traditional, shall refer to the end of the instrument that is closer to the user, while the term "distal" shall refer to the end that is farther from the user. Similar reference numbers are used for elements that are the same or similar to elements illustrated or described herein. In addition, as used herein, terms referencing orientation, e.g., "top", "bottom", "up", "down", "left", "right", "clockwise", "counterclockwise", "upper", "lower", and the like, are used for illustrative purposes with reference to the figures and features shown therein. It is to be understood that embodiments in accordance with the present disclosure may be practiced in any orientation without limitation.

[0028] Referring to FIG. **1**, a bipolar surgical instrument **10** is shown generally and includes a housing **20**, a handle assembly **30**, a trigger assembly **70**, a rotating assembly **80**, and an end effector assembly **90**, such as, without limitation, a forceps or hemostat, which mutually cooperate to grasp, seal, and/or divide tubular vessels and vascular tissue. As shown, handle assemblies **30** of instrument **10** are of the pistol grip-type, however, any suitable type of handle is envisioned within the scope of the present disclosure. The handle assembly **30** offers a surgeon a gripping position from which to grasp instrument **10** and to transmit a clamping pressure to end effector assembly **90**. Instrument **10** includes a shaft **12**, which has a distal end **14** configured to mechanically engage end effector assembly **90**, and a proximal end **16** configured to mechanically engage housing **20**.

[0029] As depicted in FIG. **1**, shaft **12** of instrument **10** is relatively elongated. The relatively elongated shaft **12** of instrument **10** enables instrument **10** to be used in performing endoscopic surgical procedures. Shaft **12** may alternatively have a shorter, or longer, shaft than that shown in FIG. **1**, which may be desirably utilized in various endoscopic and/or open surgical procedures. Rotating assembly **80** is attached to a distal end of housing **20** and is rotatable in either direction about a longitudinal axis of the shaft **12**. In some embodiments, rotating assembly **80** is rotatable approximately 180 degrees in either direction about a longitudinal axis of the shaft **12**. Rotation of rotating assembly **80** correspondingly rotates jaw assembly **90** about the longitudinal axis of shaft **12**. In some embodiments, as seen in FIGS. **2** and **3**, shaft **12** is bifurcated at distal end **14** thereof to form ends **14***a* and **14***b*, which are configured to receive jaw assembly **90**.

[0030] Instrument **10** further may include an electrical cable **60** extending from housing **20** which couples instrument **10** to a source of electrosurgical energy, e.g., a generator (not explicitly shown). In some embodiments, a source of electrosurgical energy (not explicitly shown), and/or a power source, such as without limitation, a rechargeable battery (not shown), may be included within instrument **10**, e.g., within the housing **20** thereof.

[0031] Handle assembly **30** includes a first handle **50** and a second handle **40**. Second handle **40** is selectively movable about a pivot (not shown) from a first position in spaced relation relative to first handle **50** to a second position in closer proximity relative to first handle **50** which imparts movement of jaw members **210** and **220** relative to one another, e.g., from an open to closed position about tissue. As shown in greater detail in FIG. **2**, jaw assembly **90** is attached to distal end **14** of shaft **12** and includes a pair of opposing jaw members **210** and **220**. For illustrative purposes, jaw member **210** may be referred to as an upper jaw member **210** and jaw member **220** may be referred to as a lower jaw member **220**. First and second handles **40**, **50** are ultimately connected to a drive rod (not explicitly shown) which, together, mechanically cooperate to impart movement of jaw members **210**, **220** from an open position wherein the jaw members **210**, **220** are disposed in spaced relation relative to one another, to a clamping or closed position wherein, e.g., jaw members **210**, **220** cooperate to grasp tissue therebetween.

[0032] Jaw members **210** and **220** are seated within a cavity **18** defined between bifurcated ends **14***a* and **14***b* of shaft **12**. Jaw members **210** and **220** include mutually corresponding component features which cooperate to permit rotation about a pivot pin **260** to effectively grasp, seal, and/or divide tissue. Jaw members **210**, **220** each include a jaw housing **216**, **226**, an insulative substrate or insulator **214**, **224** and an electrically conductive surface or electrode **212**, **222**. Insulators **214**, **224** are configured to securely engage the electrodes **212**, **224**. This may be accomplished by, e.g., stamping, by overmolding, by overmolding a stamped electrically conductive sealing plate and/or by overmolding a metal injection molded seal plate. Such manufacturing techniques produce a jaw assembly having an electrode **212**, **222** which is substantially surrounded by an insulating substrate **214**, **224**. Insulating substrate **214**, **224**, electrode **212**, **222**, and the outer, non-conductive jaw housings **216**, **226** are preferably configured to limit and/or reduce many of the known undesirable effects related to tissue sealing, e.g., flashover, thermal spread and stray current dissipation. Alternatively, jaw members **210** and **220** may be manufactured from a ceramic-like material and electrically conductive surfaces **212**, **222** coated onto the ceramic-like jaw members **210**, **220**.

[0033] Electrodes **212**, **222** may also include an outer peripheral edge which has a radius and insulators **214**, **224** that meet electrodes **212**, **222** along an adjoining edge which is generally tangential to the radius and/or meets along the radius. At the interface, electrodes **212**, **222** are raised relative to insulator **214**, **224**.

[0034] Jaw members **210**, **220** may be electrically isolated from one another such that electrosurgical energy can be effectively transferred through the tissue to form the seal. Electrodes **212**, **222** of jaw members **210**, **220**, respectively, may be relatively flat to avoid current concentrations at sharp edges and to avoid arcing between high points. In addition, and due to the reaction force of the tissue when engaged, jaw members **210**, **220** may be manufactured to resist bending. For example, jaw members **210**, **220** may be tapered along the width thereof which is advantageous for two reasons: 1) the taper will apply constant pressure for a constant tissue thickness at parallel, and 2) the thicker proximal portion of jaw members **210**, **220** will resist bending due to the reaction of the tissue.

[0035] Jaw members **210**, **220** may be curved in order to reach specific anatomical structures. For example, dimensioning jaws **210**, **220** at an angle of about 50 degrees to about 70 degrees is preferred for accessing and sealing specific anatomical structures relevant to prostatectomies and cystectomies, e.g., the dorsal vein complex and the lateral pedicles.

[0036] As best seen in example embodiments shown in FIGS. **2** and **3**, electrodes **212**, **222** include a first, larger contact area **212***a*, **222***a* and a second smaller contact area **212***b*, **222***b*. Larger contact areas **212***a*, **222***a* are arranged in a mutually corresponding configuration with respect to jaw members **210**, **220** such that contact area **212***a* mates with contact area **222***a* when jaw members **210**, **220** are in a closed position, e.g., when grasping tissue therebetween. Similarly, smaller contact areas **212***b* and **222***b* are arranged in a mutually corresponding configuration such that contact area **212***b* mates with contact area **222***b* when jaw members **210**, **220** are in a closed position. During use, the larger contact areas of electrodes **212***a*, **222***a* may be used to grasp the patient-side of a vessel and/or the smaller contact areas of electrodes **212***b*, **222***b* may be used to grasp tissue, vessels, etc. slated for resection. During a vessel sealing procedure, the larger contact areas of electrodes **212***a*, **222***a* enable the delivery of electrosurgical energy at a density sufficient to form a burst-resistant vessel seal on the patient side of the jaws. Conversely, the narrower electrodes **212***b*, **222***b* enable the deliv-

ery of electrosurgical energy to the resection side of the jaw members **210**, **200** to produce a smaller seal.

[0037] In one envisioned embodiment, the size ratio of the larger contact area **212***a*, **222***a* to the second smaller contact area **212***b*, **222***b* is about 3:1, however, the size ratio may be in a range of about 1.2:1 to about 10:1 and in some embodiments may range up to 100:1 or greater. In some embodiments, the width ratio of the width of the larger contact area **212***a*, **222***a* to the second smaller contact area **212***b*, **222***b* is about 3:1, however, the width ratio may be in a range of about 1.2:1 to about 10:1 and in some embodiments may range up to 100:1 or greater.

[0038] A conductor **310***a* electrically couples electrode **212** (which includes wide electrode **212***a* and narrow electrode **212***b*) to a source of electrosurgical energy as described hereinabove. Similarly, conductor **310***b* electrically couples electrode **222** (e.g., wide electrode **222***a* and narrow electrode **222***b*) to a source of electrosurgical energy.

[0039] In another aspect, jaw housings **216**, **226** include a visual indicator **218***a* and **218***b* that is configured to enable a surgeon to readily ascertain jaw member orientation. In the example embodiment depicted in FIGS. **2** and **3**, visual indicator **218***a* includes an intaglio arrowhead icon formed in an outer surface of jaw housing **216** that indicates the position of the wide electrode **212***a*. Similarly, visual indicator **212***b* includes an intaglio arrowhead icon formed in an outer surface of jaw housing **216** that indicates the position of narrow electrode **212***b*. As shown in the drawings, indicators **218***a* and **218***b* indicate the wide and narrow electrodes **212***a*, **212***b* by using corresponding wide and narrow arrows **218***a*, **218***b*. The visual indicators **218***a*, **218***b* may include arrows, or may include any other icon to represent the wide and narrow electrodes **212***a*, **212***b*, respectively. The design of visual indicators **218***a*, **218***b* may include a mnemonic element that enables "at a glance" intuitive interpretation by the surgeon. Other envisioned indicators include a large circle/small circle, single bar/double bar, pictograph, different colors, and so forth. While not explicitly shown in the figures, visual indicators may be included in lower jaw member **226** to enable a surgeon to identify electrode orientation regardless of the rotated position of the jaw member **216**, **226**. Additionally or alternatively, visual indicators **218***a*, **218***b* may be formed by any suitable marking technique, e.g., in raised relief, laser etching, stamping, molding, machining, pigment, ink, dye, overmolding, and the like. Additionally or alternatively, visual indicators **218***a*, **218***b* may be positioned on shaft **12** and/or rotating assembly **80** as long as they correspond to jaw member orientation.

[0040] As seen in FIGS. **2** and **3**, in order to achieve a desired gap range (e.g., about 0.001 to about 0.006 inches) and apply a desired force to seal the tissue, at least one jaw member **210** and/or **220** includes one or more stop members **239** that limit the movement of the two opposing jaws **210**, **220** relative to one another. Each stop member **239** is made from an insulative material and is dimensioned to limit opposing movement of jaw members **210**, **220** to within the above gap range.

[0041] A knife channel **215** may be defined through the center of jaw member **220** such that a knife **305** having a distal cutting edge **306** may cut through the tissue grasped between jaw members **210** and **220** when jaw members **210** and **220** are in a closed position, as illustrated with reference to FIGS. **6**A and **611**. Details relating to the knife channel **215**, knife **305**, trigger assembly **70**, and a knife actuation assembly associated therewith (not explicitly shown) are explained in limited detail herein and explained in more detail with respect to commonly-owned U.S. Pat. Nos. 7,156,846 and 7,150,749 to Dycus et al.

[0042] Housing **20** is formed from two housing halves that engage one another via a series of mechanical interfaces to form an internal cavity for housing the internal working components of instrument **10**. For the purposes herein, the housing halves are generally symmetrical and, unless otherwise noted, a component described with respect to a first of the housing halves will have a similar component which forms a part of a second of the housing halves.

[0043] As mentioned above, first handle **50** and second handle **40** of handle assembly **30** cooperate with one another and with housing **20** to activate a first mechanical linkage (not shown) which, in turn, actuates a drive assembly (not shown) for imparting movement of opposing jaw members **210**, **220** relative to one another to grasp tissue therebetween.

[0044] Handle assembly **130** further includes a trigger assembly **70** that cooperates with a knife actuation assembly (not explicitly shown) which enables the extension of knife **305** from a first, proximal, position as depicted in FIG. **6**A, to a second, distal position as depicted in FIG. **6**B to sever tissue grasped between jaw members **210**, **220**. Knife **305** travels within knife channel **215** formed within jaws **210**, **220**. In an embodiment, trigger assembly **70** may include a lockout (not explicitly shown) that inhibits actuation of knife **305** while jaws **210**, **220** are in an open position.

[0045] As discussed above, by controlling the intensity, frequency and duration of the electrosurgical energy applied to the tissue, the surgeon can cauterize, coagulate, desiccate, seal and/or simply reduce or slow bleeding. In addition, the disclosed instrument may be operated in one of a plurality of polarity configurations to achieve specific surgical objectives. For example, in a vessel sealing configuration, electrodes **212***a* and **212***h* (associated with upper jaw member **210**) have a positive polarity (e.g., active electrodes) while electrodes **222***a* and **222***b* (associated with lower jaw member **220**) have a negative polarity (e.g., return electrodes.) In this generally bipolar configuration, blade **305** is electrically deactivated and severs tissue by physically cutting tissue (e.g., vessel) held between jaws **210**, **220**. Additionally or alternatively, electrosurgical energy is delivered to a vessel grasped between jaws **210**, **220** to effectuate the sealing of the vessel.

[0046] In another configuration adapted for cutting, blade **305** is electrically coupled to a source of electrosurgical energy to form an active (e.g., positive) electrode. Electrodes **212***a*, **212***b*, **222***a*, and **222***b* are configured as a negative, or return, electrode, During use, blade **305** effectuates cutting via cutting edge **306** and/or the electrosurgical cutting energy delivered between blade **305**, cutting edge **306**, and electrodes **212***a*, **212***b*, **222***a*, and **222***b*.

[0047] In yet another embodiment depicted in FIGS. **4** and **5**, a jaw assembly **290** includes an upper jaw member **310** and a lower jaw member **320**. Upper jaw member includes an electrode array **312** having two independent electrodes **312***a* and **312***b*. Electrode **312***a* has a greater surface area than the narrower electrode **312***b*. Correspondingly, lower jaw member **320** includes a electrode array **322** having two independent electrodes **322***a* and **322***b*, wherein electrode **322***a* has a greater surface area than the narrower electrode **322***b*. As can be appreciated, electrode arrays **312** and **322** are arranged in a mutually corresponding configuration wherein electrode

312*a* mates with electrode **322***a,* and electrode **312***b* mates with electrode **322***b,* when the jaw members **310** and **320** are in a closed configuration.

[0048] Each of the four electrodes **312***a,* **312***b,* **322***a,* and **322***b* are independently coupled to one or more sources of electrosurgical energy. As seen in FIG. **5**, electrode **312***a* is coupled to a source of electrosurgical energy by a conductor **410***a,* and electrode **312***b* is coupled to a source of electrosurgical energy by a conductor **411***a.* Electrodes **322***a* and **322***b* are coupled to a source of electrosurgical energy by conductors **410***b* and **411***b,* respectively. In an envisioned embodiment, electrodes **312***a,* **312***b,* **322***a,* and **322***b* and knife **405** may be independently selectively assigned to a positive or negative polarity (e.g., designated as an active or return electrode.) In this embodiment a total of 32 electrode configurations are available to the surgeon.

[0049] For example, and without limitation, wide electrodes **312***a* and **322***a* may be configured in a bipolar arrangement to facilitate vessel sealing on the patient side. On the resection (narrow electrode) side, blade **405** may be configured as an active (+) electrode while narrow electrodes **312***b* and **322***b* are configured as a return (−) electrode.

[0050] In another embodiment, electrodes may be alternatively or sequentially energized, either individually or in combination, to achieve effectively simultaneous cutting, coagulating, sealing, etc. In another non-limiting example, a source of electrosurgical energy may be configured to provide, during a first time period, vessel sealing energy to a first pair of electrodes **312***a* and **322***a;* during a second time period, the source of electrosurgical energy provides coagulation energy to a second pair of electrodes **312***b* and **322***b;* and during a third time period, the source of electrosurgical energy provides cutting energy, e.g., sending positive cutting energy to knife **405** and receiving negative cutting energy at electrodes **312***a,* **322***a,* **312***b,* and **322***b.* The time periods may be of any duration, however it is envisioned that a time period may have a duration of about 0.001 second to about 0.1 second, and continue in round robin fashion during activation (e.g., while activated by the surgeon.) Various electrode combinations, energy profiles, and sequences thereof may be specified, modified, and/or stored for later recall and use by a surgeon.

[0051] FIG. **7** illustrates another embodiment of an electrosurgical instrument **400** in accordance with the present disclosure. Instrument **400** has a generally scissors-like or hemostat-like structure suitable for use in open surgical procedures. Instrument **400** includes elongated shaft portions **440** and **450** each having a proximal end **441** and **451**, respectively, and a distal end **442** and **452**, respectively. The instrument **400** includes an end effector assembly **490** which is operably coupled to distal ends **442** and **452** of shafts **440** and **450**, respectively. The end effector assembly **490** includes pair of opposing jaw members **410** and **420** which are pivotably connected about a pivot pin **430**. The two opposing jaw members **410** and **420** of the end effector assembly **490** are pivotable about pin **430** from the open position to the closed position for grasping tissue therebetween. Jaw members **410** and **420** include asymmetrical electrodes (not explicitly shown) arranged as described hereinabove that may be coupled to a source of electrosurgical energy by cable assembly **460**. In some embodiments, a source of electrosurgical energy and/or a power source may be included in instrument **400** for "wireless" use. Instrument **400** may include at least one handswitch **480**, which may be a slide switch or a push-button switch, that is adapted to activate the delivery of electrosurgical energy to tissue. Instrument **400** may additionally or alternatively include a knife actuator **470** that is adapted to actuate a knife (not shown) for dividing tissue grasped between jaws **410** and **420**.

[0052] While several embodiments of the disclosure have been shown in the drawings, it is not intended that the disclosure be limited thereto, as it is intended that the disclosure be as broad in scope as the art will allow and that the specification be read likewise. Therefore, the above description should not be construed as limiting, but merely as exemplifications of particular embodiments. Those skilled in the art will envision other modifications within the scope and spirit of the claims appended hereto.

What is claimed is:

1. An electrosurgical instrument, comprising:

a first jaw member and a second opposing jaw member at a distal end of the electrosurgical instrument, wherein each jaw member includes an outer housing, and an inner tissue engaging surface;

at least one of the jaw members movable from a first position wherein the jaw members are disposed in spaced relation relative to one another to a second position wherein the jaw members cooperate to grasp tissue therebetween; and

an electrode disposed on the inner tissue engaging surface of at least one of the jaw members having a first contact region disposed adjacent to a first edge of the inner tissue engaging surface and a second contact region disposed adjacent to a second edge of the inner tissue engaging surface, wherein the surface area of the first contact region is greater than the surface area of the second contact region.

2. The electrosurgical instrument according to claim **1**, wherein the ratio of the surface area of the first contact region to the surface area of the second contact region is about 3:1.

3. The electrosurgical instrument according to claim **1**, wherein the ratio of the surface area of the first contact region to the surface area of the second contact region is in a range of about 1.2:1 to about 10:1.

4. The electrosurgical instrument according to claim **1**, further comprising a rotating assembly for rotating the jaw members about a longitudinal axis of the electrosurgical instrument,

5. The electrosurgical instrument according to claim **1**, wherein the ratio of the width of the first contact region to the surface area of the second contact region is in a range of about 1.2:1 to about 10:1.

6. The electrosurgical instrument according to claim **1**, wherein the electrode is configured to electrically couple with a source of electrosurgical energy.

7. The electrosurgical instrument according to claim **1**, further comprising a visual indicator disposed on the outer housing, wherein the visual indicator indicates a position of the first contact region or the second contact region.

8. The electrosurgical instrument according to claim **1**, further comprising:

a knife channel defined longitudinally along the inner tissue engaging surface of the jaws;

a knife having a distal cutting edge and configured to traverse between a first position where the cutting edge is positioned proximally of the knife channel and a second position where the cutting edge is positioned at a distal end of the knife channel.

9. The electrosurgical instrument according to claim **8**, wherein the knife is configured to electrically couple with a source of electrosurgical energy.

10. An electrosurgical instrument, comprising:

a pair of opposing jaw members at a distal end of the electrosurgical instrument, wherein each jaw member includes an outer housing, and an inner tissue engaging surface corresponding to the inner tissue engaging surface of the opposing jaw;

at least one jaw member being movable relative to the other jaw member from a first position wherein the jaw members are disposed in spaced relation relative to one another to a second position wherein the jaw members cooperate to grasp tissue therebetween;

a first electrode disposed on an inner tissue engaging surface and disposed adjacent to a first edge of the inner tissue engaging surface; and

a second electrode disposed on an inner tissue engaging surface and disposed adjacent to a second edge of the inner tissue engaging surface, wherein the width of the first electrode is greater than the width of the second electrode.

11. The electrosurgical instrument according to claim **10**, wherein the ratio of the width of the first electrode to the width of the second electrode is about 3:1.

12. The electrosurgical instrument according to claim **10**, wherein the ratio of the width of the first electrode to the width of the second electrode is in a range of about 1.2:1 to about 10:1.

13. The electrosurgical instrument according to claim **10**, further comprising a rotating assembly for rotating the jaw members about a longitudinal axis of the electrosurgical instrument.

14. The electrosurgical instrument according to claim **10**, wherein at least one of the first electrode or the second electrode is configured to electrically couple with a source of electrosurgical energy.

15. The electrosurgical instrument according to claim **10**, further comprising a visual indicator disposed on the outer housing, wherein the visual indicator indicates a position of at least one of the first electrode or the second electrode.

16. The electrosurgical instrument according to claim **10**, further comprising:

a knife channel defined longitudinally in the inner tissue engaging surface of the jaws;

a knife having a distal cutting edge and configured to traverse between a first position where the cutting edge is positioned proximally of the knife channel and a second position where the cutting edge is positioned at a distal end of the knife channel.

17. The electrosurgical instrument according to claim **16**, wherein the knife is configured to electrically couple with a source of electrosurgical energy.

18. A method of treating a vessel, comprising the steps of:

providing an instrument having a first opposing jaw member and a second opposing jaw member, wherein each opposing jaw member includes a first opposing contact region and a second opposing contact region, the first opposing contact region having a surface area greater than the surface area of the second opposing contact region;

positioning the vessel between the jaws, wherein the first opposing contact regions are disposed over a first portion of the vessel and the second opposing contact regions are disposed over a second portion of the vessel

closing the jaws to grasp the vessel therebetween;

applying electrosurgical energy to the vessel via the first electrode and the second electrode to effect a seal in the first portion of the vessel and to effect hemostasis in the second portion of the vessel.

19. The method of treating a vessel according to claim **18**, wherein a positive electrosurgical polarity is applied to the vessel by the first contact region and a negative electrosurgical polarity is applied to the vessel by the second contact region.

20. The method of treating a vessel according to claim **18**, further comprising dividing the vessel using a knife coupled to a source of electrosurgical energy, wherein a negative electrosurgical polarity is applied to the vessel by the first contact region and the second contact region, and a positive electrosurgical polarity is applied to the vessel by the knife.

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